



The Energy Mix of a Sustainable Future

Delhi Sustainable Development Summit

New Delhi, 2 – 4 February 2006

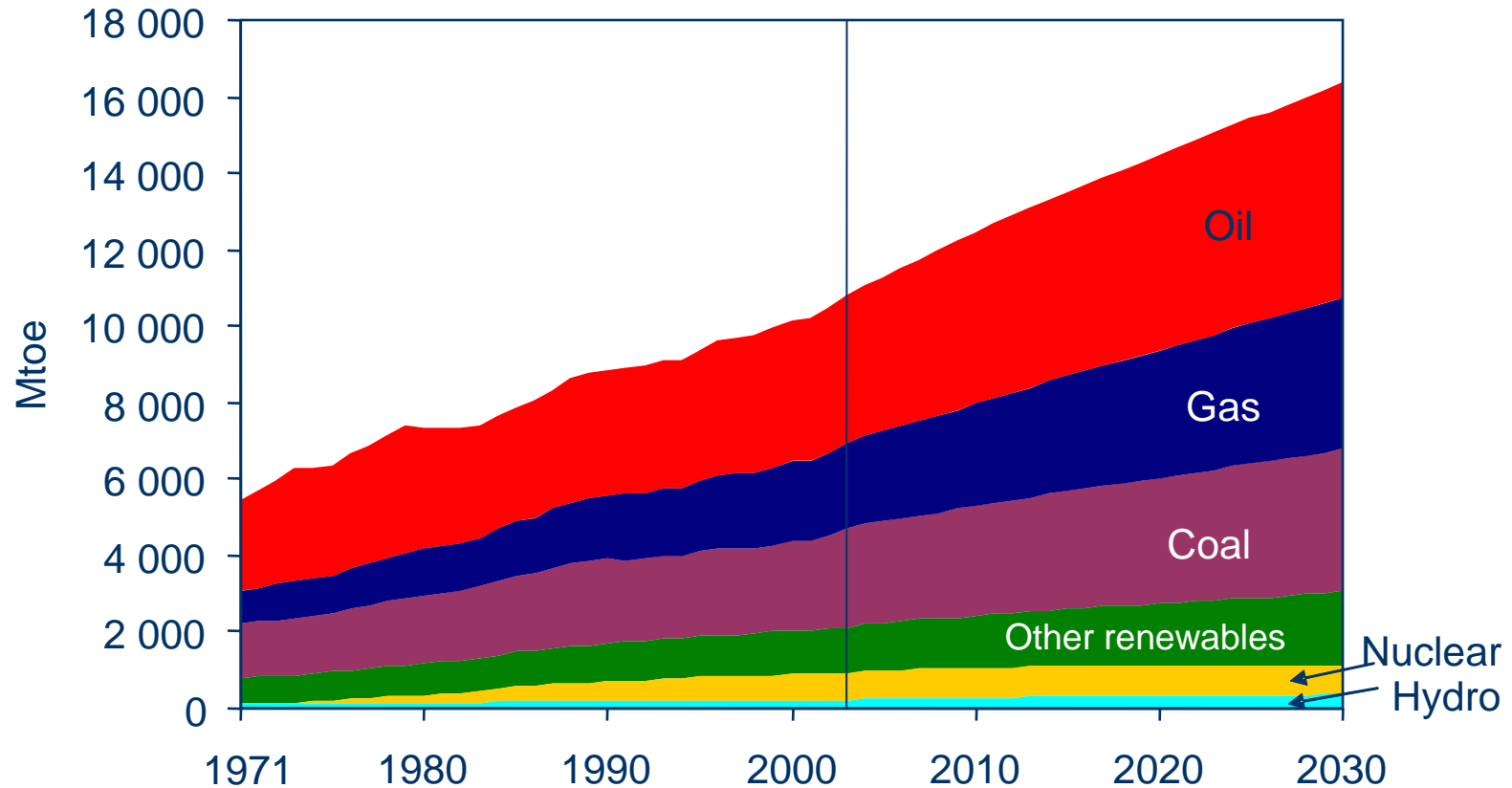
Claude Mandil

Executive Director

International Energy Agency



World Primary Energy Demand



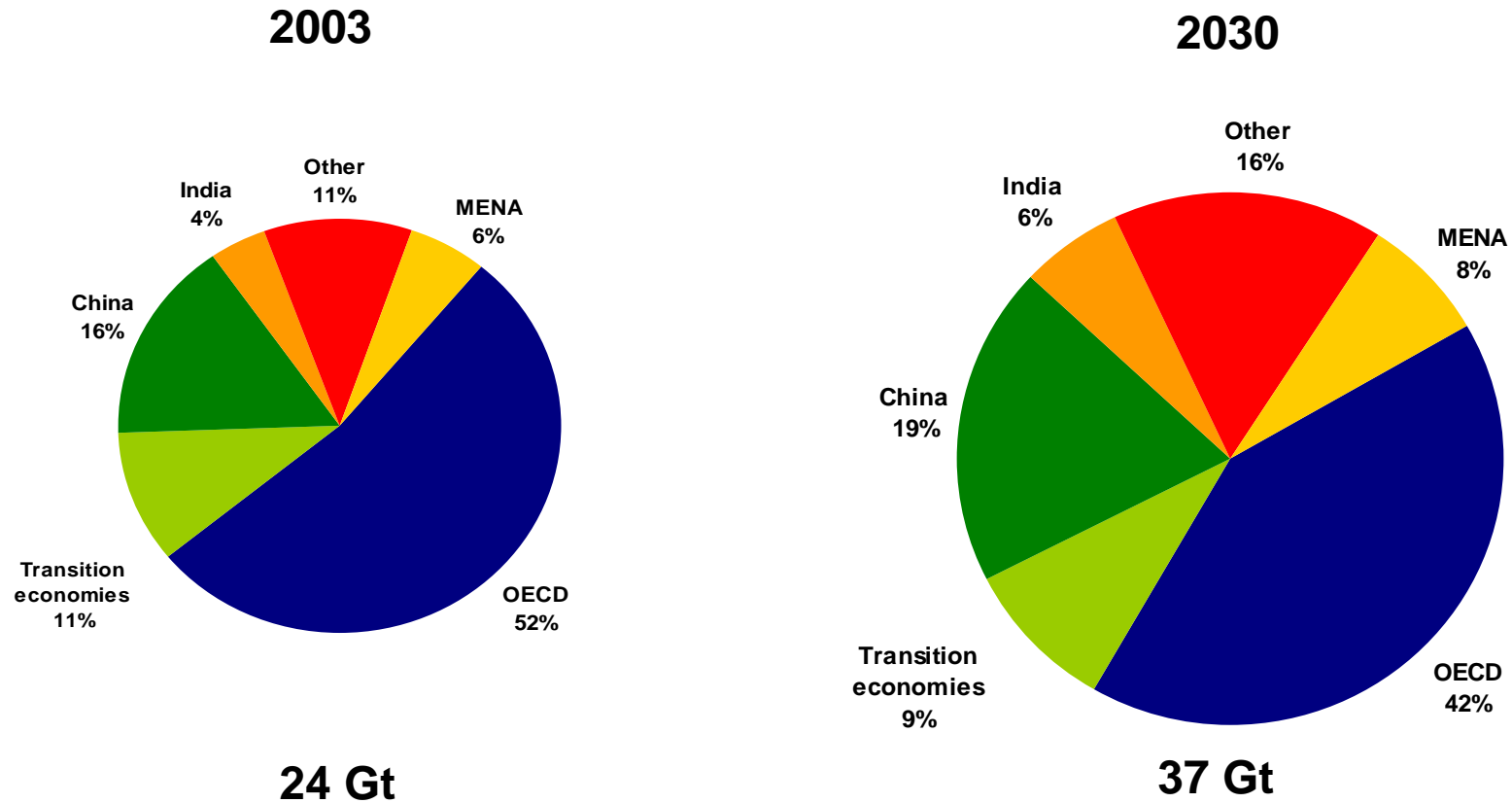
World Energy Demand rises by 52 % between now and 2030 in the Reference Scenario



**This is Not
Sustainable!**

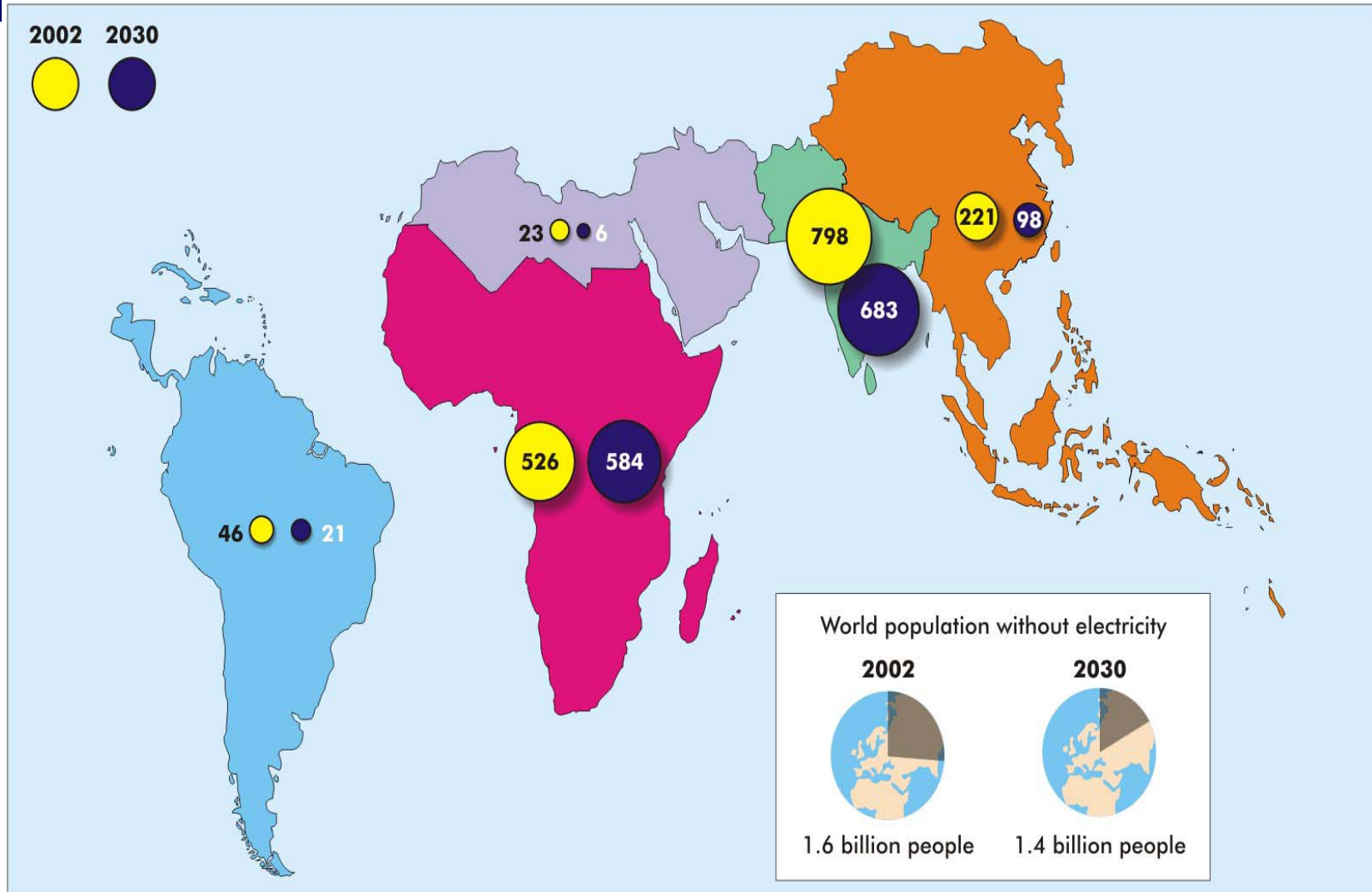


Global Energy-Related CO₂ Emissions



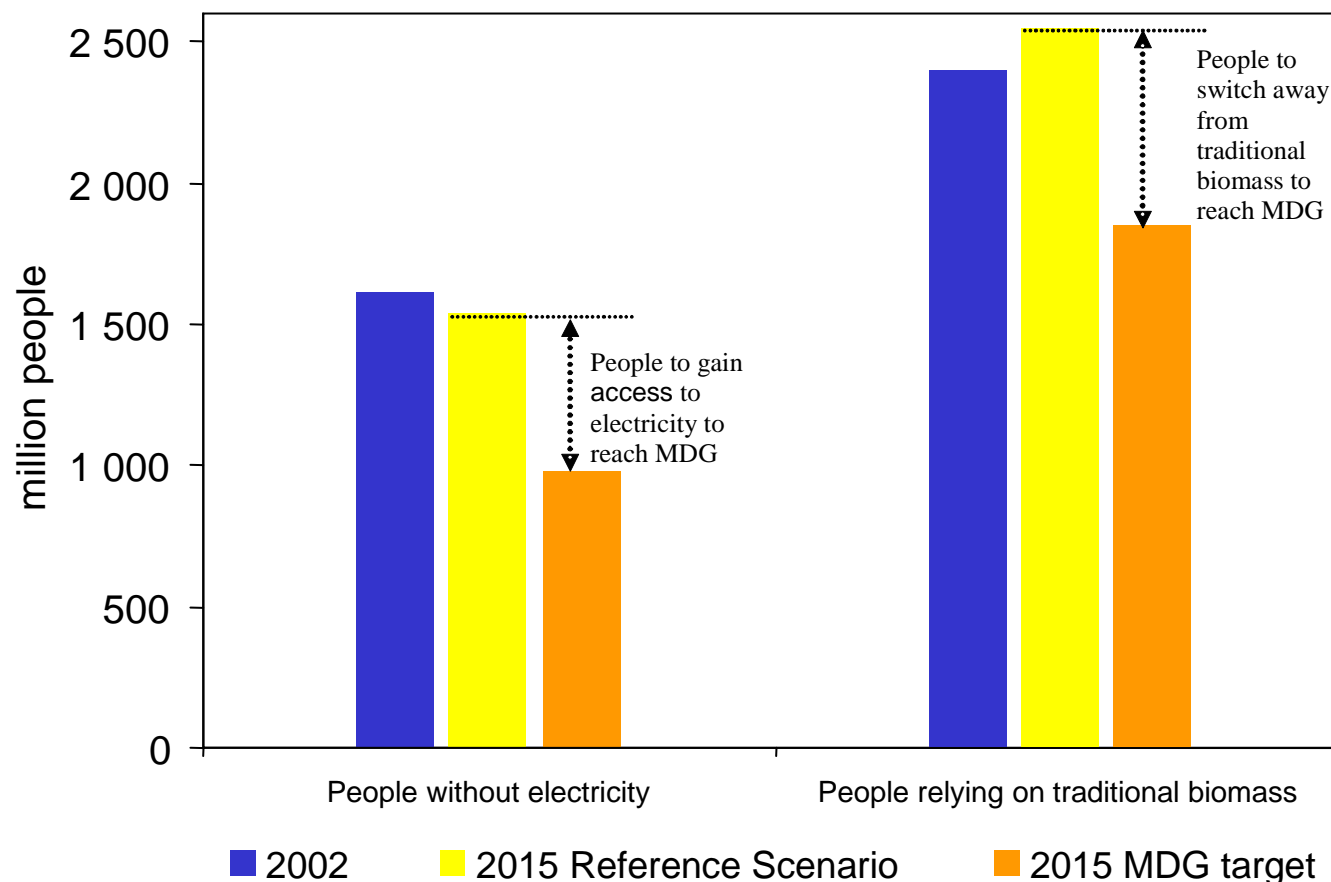


Electricity Deprivation





The Energy Implications of Halving Poverty in Developing Countries by 2015



If the MDGs were to be reached, 500 million people more would need to be electrified and 700 million people would need to switch away from unsustainable biomass in 2015.



**But the future is not
predetermined...**

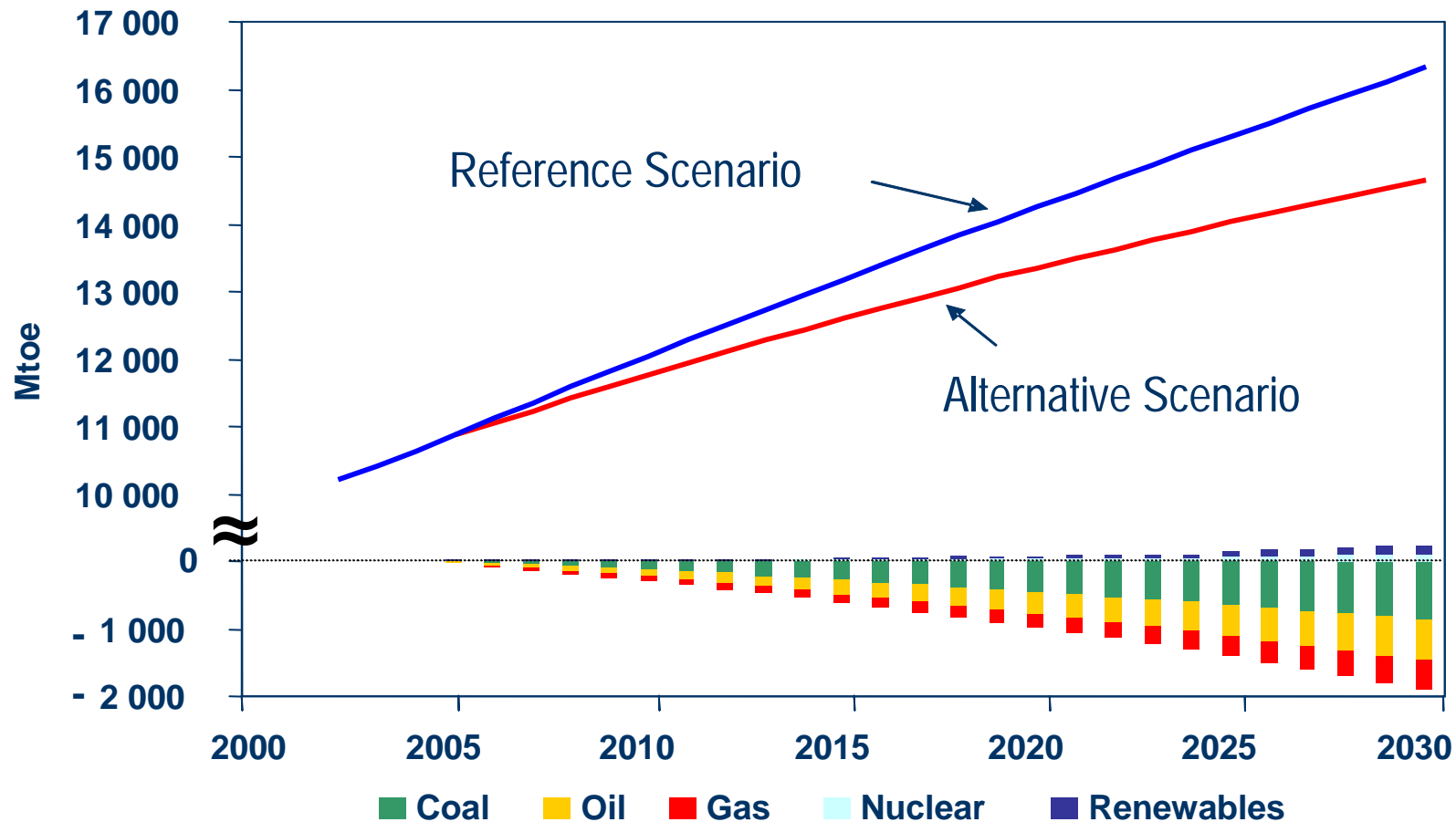


The World Alternative Policy Scenario

- Analyses impact of new environmental & energy-security policies worldwide
- Impact on fuel mix, CO₂ emissions & investment needs
- Basic macroeconomic & population assumptions as for Reference Scenario, but energy prices change



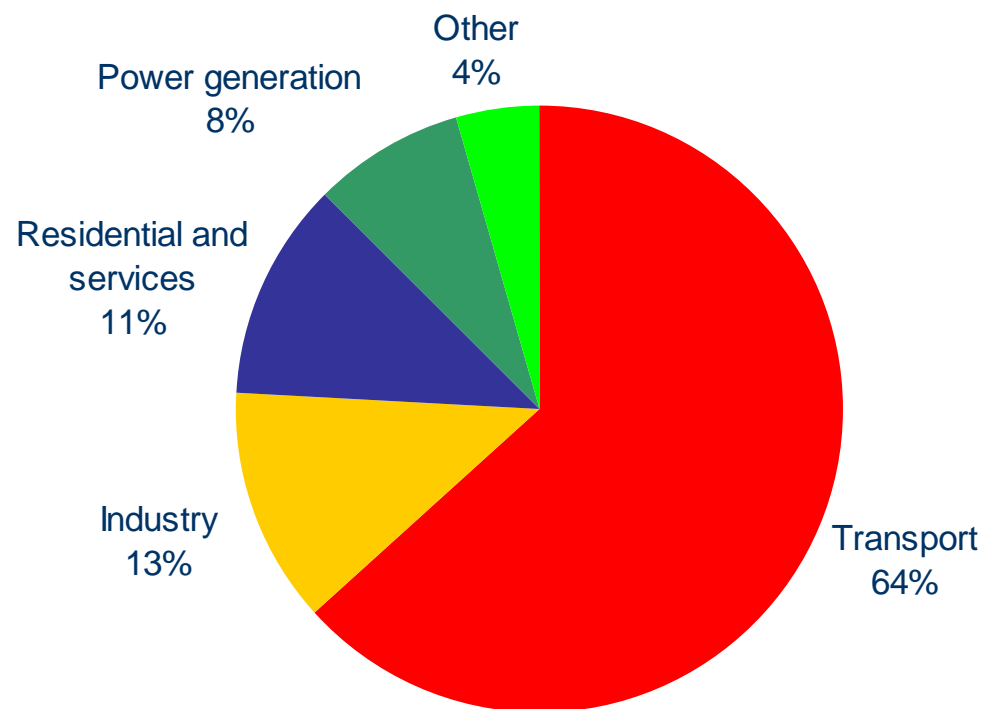
World Primary Energy Demand in Reference & Alternative Scenarios



Coal demand falls most among fossil fuels



Reduction in Oil Demand in the Alternative vs. Reference Scenario 2030

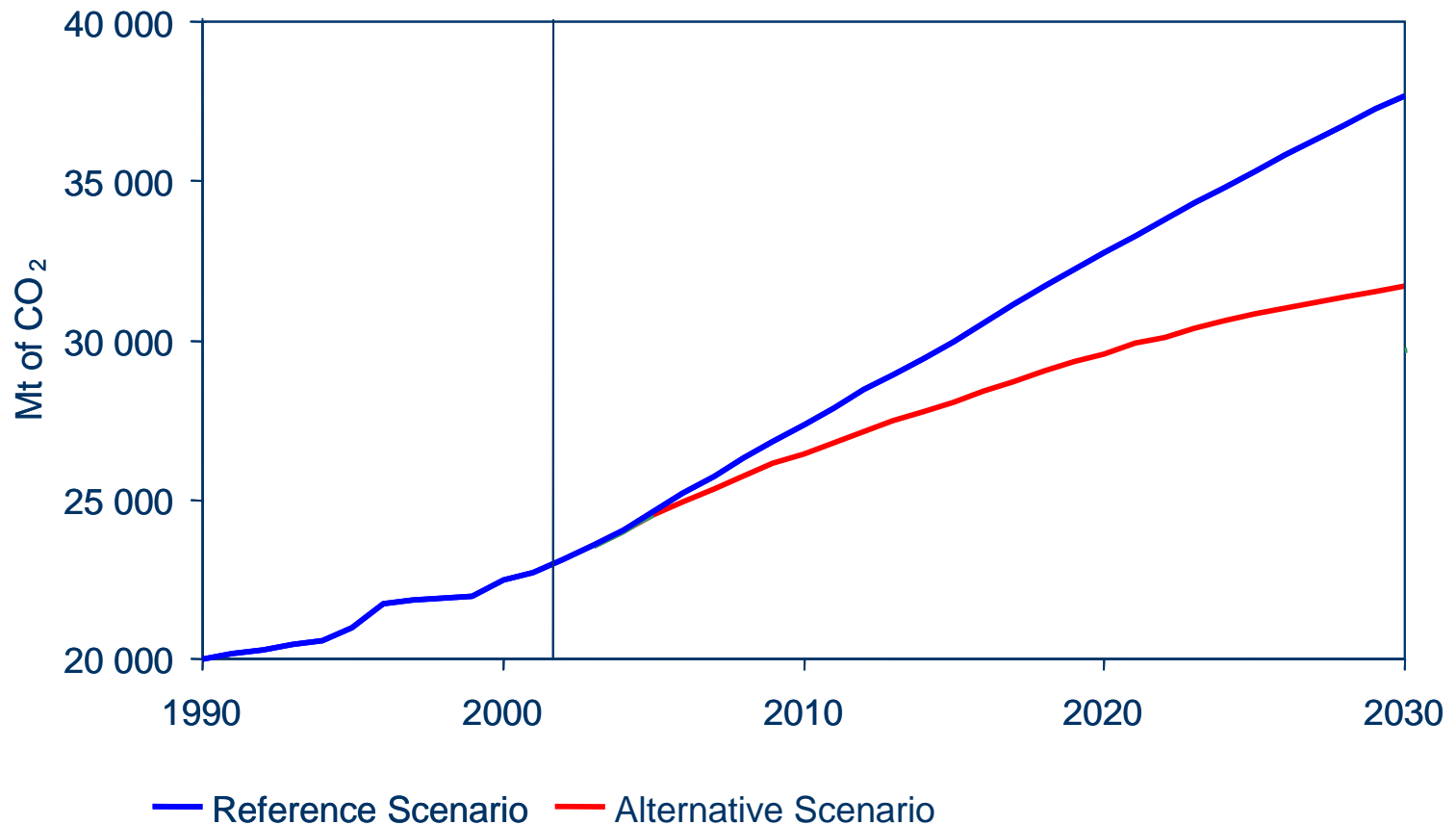


Oil savings = 12.8 mb/d

Oil savings in 2030 would be equivalent to the combined current production of Saudi Arabia, UAE and Nigeria



Global CO₂ Emissions in the Reference & Alternative Scenarios

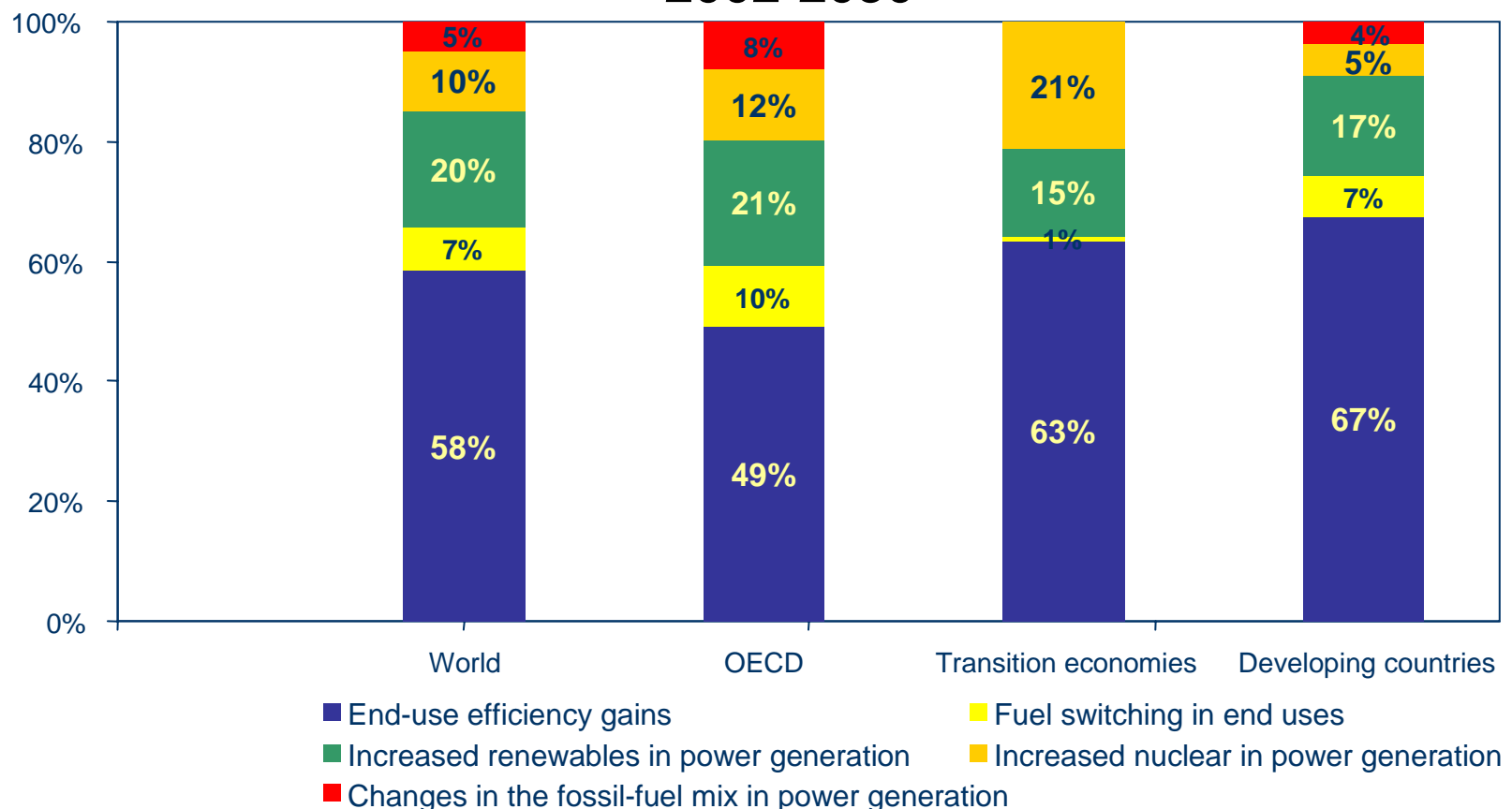


**CO₂ emissions are 16% less in the Alternative Scenario in 2030 –
But are still more than 50% higher than 1990**



Contributory Factors in CO₂ Reduction Alternative vs. Reference Scenario

2002-2030



Improvements in end-use efficiency contribute for more than half of decrease in emissions, and renewables use for 20%



Energy Efficiency Has A Key Role To Play And Is Available In The Short Term



High performance buildings



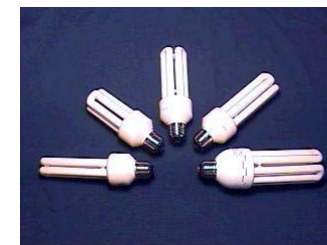
Least life-cycle cost appliances



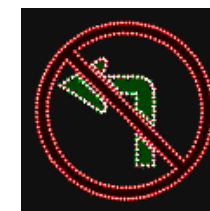
Labelling and certification

Energy efficiency offers:

- substantial energy and greenhouse gas savings at low or negative cost
- energy security and reliability benefits
- enhanced business competitiveness and social welfare



Compact Fluorescent Lamps



LED traffic lights



Efficient information and communication technologies

Reducing standby power consumption



Super windows & daylighting



Long Term: The Technology Challenge



Avoiding 1 Billion Tons of CO₂ per Year

Coal	Replace 300 conventional, 500-MW coal power plants with “zero-emission” power plants, which means.....
CO ₂ Sequestration	Install 1000 Sleipner CO ₂ sequestration plants
Wind	Install 200 x current US wind generation in lieu of unsequestered coal
Solar PV	Install 1300 x current US solar generation in lieu of unsequestered coal
Nuclear	Build 140 1-GW power plants in lieu of unsequestered coal plants

**To meet the energy demand & stabilize CO₂ concentrations
unprecedented technology changes must occur in this century**

[Adapted from Pacala & Socolow, *Science* 2004]



The Technology Challenge

Stabilising Greenhouse Gas Concentrations in the Atmosphere

No single technology or policy can do it all

Different

- regions
- markets
- scale-up requirements
- infrastructures
- resources
- preferences
- technology timing



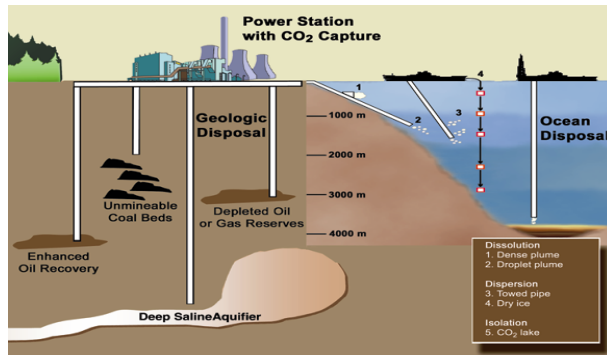
Vehicles: Efficiency, Bio-fuels, Hydrogen Fuel Cells



Zero Net Emission Bldgs., Industrial Efficiency, CHP



Nuclear Power Generation IV



Carbon (CO₂) Sequestration



Renewable Energy Technologies



Bio-Fuels and Power



Advanced Power Grids



Key Message:

- **Not one Solution, but some features are clear**
 - Energy Efficiency ... available now at low or no cost !
 - Natural Gas, Coal ... with CO₂ capture & storage
 - Biofuels, Renewables ... with lower costs, higher availability
 - Nuclear Energy ... with safe waste management
 - H₂ & Fuel Cells ... with lower cost and technical advances
 - Fusion ... maybe, in the very long term
- **Need to pursue a “Portfolio” approach for policy, technology deployment and R&D**